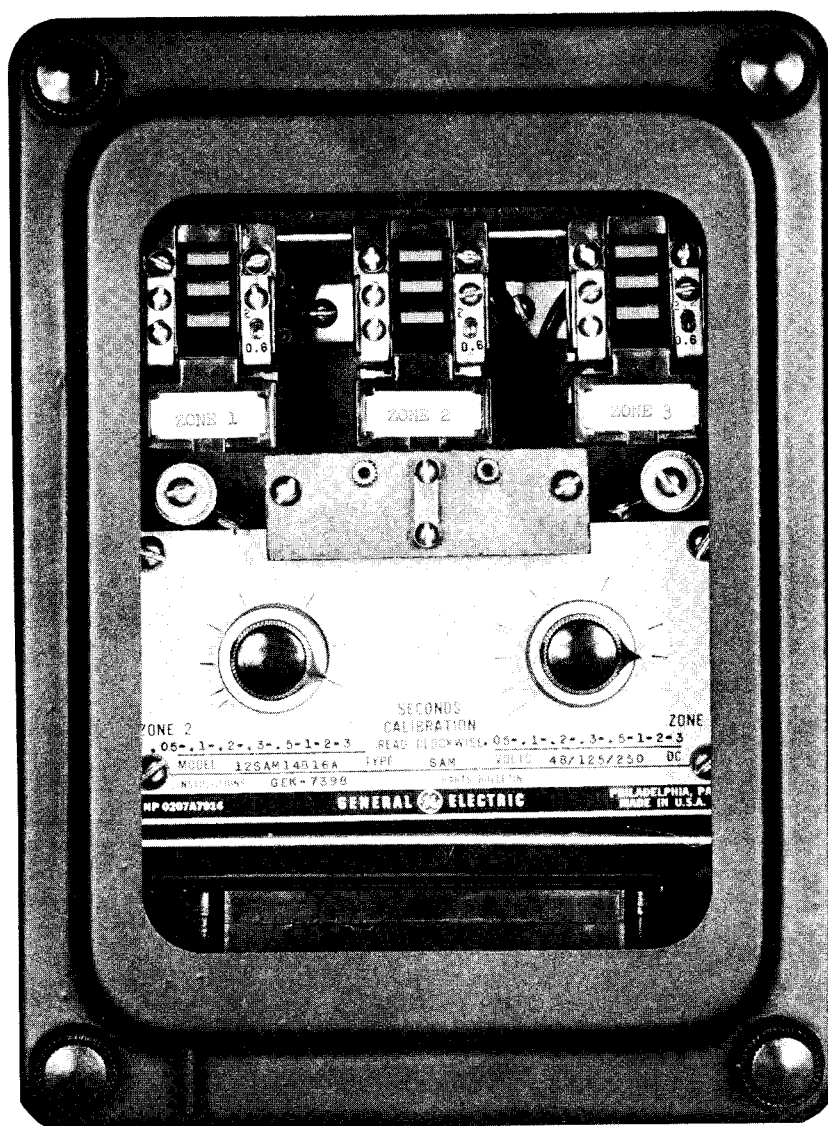




INSTRUCTIONS

DC OPERATED TIMING RELAY TYPES: SAM14A12A AND UP AND SAM14B15A AND UP



GE Protection and Control
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COVER PHOTO (8039984)

D-C OPERATED TIMING RELAY
TYPE SAM14A12A AND UP AND SAM14B15A AND UP

DESCRIPTION

The SAM14A and SAM14B relays are highly accurate static timing relays designed for use with phase-packaged distance relays. They contain two independently adjustable timing circuits, each with its-contact output, for second and third zone times. The SAM14A has two targets, one for second zone and the other for third zone; the SAM14B includes a third target for first zone. Both relays are furnished in the size S1 case.

APPLICATION

The SAM14A and SAM14B relays find application wherever a highly accurate, repetitive, quick reset distance relay timer having negligible overtravel is desired. Specifically, the relays were designed to be used as a second and third zone timer in conjunction with phase-packaged distance relays that do not contain auxiliary S relays. This excludes all zone-packaged relays and such phase-packaged relays as the GCX17A and B, and the GCXY11A. The RPM11D should be used with these phase-packaged relays while another type of SAM relay is available for zone-packaged relays.

One SAM14 relay would be used with a set of three phase-packaged relays to provide three-step phase or ground step-distance protection. Fig. 4 shows a typical external connection diagram showing how one SAM14B would be used with three GCY51A relays to provide three-step distance protection.

RATINGS

The SAM14A and SAM14B relays covered by these instructions have a triple DC voltage rating of 48, 125 and 250 volts, selected by means of a link setting which can be made from the front of the relay.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise that are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

To the extent required the products described herein meet applicable ANSI, IEEE and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

TABLE I

Volts	Current Inductive*	Current Non-Inductive
48 V DC	1.0	3.0
125 V DC	0.5	1.5
250 V DC	0.25	0.75
115 V 60 Cyc	0.75	2.0
230 V 60 Cyc	0.5	1.0

* Inductance of average trip coil

The contacts of the auxiliary units TU2 and TU3 will close and carry momentarily 30 amperes DC at control voltages of 250 volts or less. These contacts will carry 3 amperes continuously and have an interrupting rating as shown in Table I.

The 1.0/4.0 ampere targets used in the SAM14B relays have ratings as shown in Table II.

TABLE II

	1 Amp Tap	4 Amps Tap
Minimum Operating	1.0 Amps	4.0 Amps
Carry continuously	2.5 Amps	6 Amps.
Carry 30 amps for	1 Sec.	5 Secs.
Carry 10 amps for	10 Secs.	50 Secs.
DC Resistance	0.25 Ohms	0.034 Ohms
60 Cyc. Impedance	2.0 Ohms	0.13 Ohms

OPERATING PRINCIPLES

The operating principles of the SAM14 timing circuits can best be described with the aid of the simplified schematic diagram of Fig. 5 which shows the TU2 timing circuit. The timing sequence is initiated by a contact of the TX auxiliary unit, which is picked up by the protective relay. Basically the circuit measures the time it takes to charge a capacitor (C_1) to a definite voltage through an adjustable resistor (R_1). Zener regulators (Z_1) hold the voltage across the resistor-capacitor combination at a constant value so that charging time will vary directly with the setting of R_1 and will be practically independent of fluctuations in the DC voltage supply. When the charge on capacitor C_1 reaches a definite value, unijunction transistor T_1 will be turned on. This in turn triggers a controlled rectifier SCR_1 which picks up the auxiliary unit TU2. If the initiating contact opens dropping out TX prior to the completion of the timing cycle, diode D_1 provides a low-resistance discharge path for the capacitor so that the timing circuit will completely reset in a very short time (see CHARACTERISTICS).

CHARACTERISTICS

The timing circuits of the SAM14A and SAM.14B relays are designed to provide an extremely accurate and stable time delay function over a calibration range of 1 or 3 seconds. The dial for each timing circuit has been calibrated at the factory for

seven (or more) operating times. For example, the 3-second timers, which are frequently used in distance relay applications, are calibrated 0.1, 0.2, 0.3, 0.5, 1.0, 2.0 and 3.0 seconds. As will be noted in Fig. 1, the calibration scale is expanded at the low end to permit more accurate short time settings.

If the calibration knob is reset in the field at one of the factory set points, the timing circuit will be accurate within $\pm 3\%$ of the dial marking if checked at rated voltage and an ambient temperature of approximately 25°C . Once set for a particular time and then subsequently rechecked under identical operating conditions without disturbing the calibration knob, the timing circuits will repeat within one percent (1%) of the original setting.

The use of zener regulators across the input to the timing circuit makes the timing circuits inherently independent of changes in the DC voltage supply. The curves in Fig. 6 show the small percentage change in time for control voltage changes from 60% to 112% of normal for nominal time settings of 0.1, 1.5 and 3.0 seconds. The larger percentage error at the 0.1 sec. time setting results from the fact that the TX unit pickup time increases at reduced voltage and this change shows up as a larger percentage at the lower time settings.

The factory calibration points on the dial plate were made in an ambient temperature of approximately 25°C . The relays can be safely operated at ambient temperatures from -20°C to $+60^{\circ}\text{C}$. The change in operating time over this ambient range will be less than $\pm 4\%$ of the time at 25°C for any time setting.

The timing circuits include a discharge rectifier (D_1 in Fig. 5) which provides a low resistance discharge path for the capacitor charge the instant that the initiating contact de-energizes the timing circuit. The reset time is 67 milliseconds (4 cycles on a 60 hertz basis). If the timing circuit is de-energized for this interval or longer, subsequent operations will occur within 3% of the nominal set operating time.

Because of the nature of the timing circuits, overtravel, which is a limitation in electro-mechanical timing relays, is practically nonexistent in the SAM14 relays.

BURDEN

Table III lists the current drawn by the TX coil circuit (stud 7 or 8), and by the timing circuit (stud 6) after TX operates. Because common resistors are used for the TX coil and regulator circuits, the current in the TX coil for the 125 and 250 V link settings will decrease when the TX contact closes. Both initial and final values are shown in the table.

CONSTRUCTION

The Type SAM14 relays are assembled in the standard small size, single-end (S1) drawout case having studs at the lower end in the rear for external connections. The electrical connections between the relay components and the case studs are made through stationary molded inner and outer blocks between which nests a removable connecting plug which completes the circuits. The outer block attached to the case has the studs for the external connections, and the inner block has the terminals for the internal connections.

The relay components are mounted on the steel framework called the cradle forming a complete unit with all leads terminated at the inner block. This cradle is held

TABLE III

Circuit	Tx Contact Position	Current for Link Setting Shown:		
		48 V	125 V	250 V
TX Coil (Stud 7 or 8)	Open	0.040	0.069	0.097
TX Coil (Stud 7 or 8)	Closed	0.034	0.036	0.0385
Timing Circuits (6)	Closed	0.10	0.12	0.12
Total	Closed	0.134	0.156	0.159

firmly in the case by latches at both top and bottom and by a guide pin at the back of the case. The connecting plug, besides making the electrical connections between the blocks of the cradle and case, also locks the latch in place. The cover, which is drawn to the case by thumbscrews, holds the connecting plug in place. The target reset mechanism is a part of the cover assembly.

A separate testing plug can be inserted in place of the connecting plug to test the relay in place on the panel either from its own source of voltage, or from other sources. Or the relay can be drawn out and replaced by another that has been tested in the laboratory.

The relay case is suitable for either semi-flush or surface mounting on all panels up to 2 inches thick and appropriate hardware is available. However, panel thickness must be indicated on the relay order to ensure that proper hardware will be included. For outline and drilling dimensions, see Fig. 11. Every circuit in the drawout case has an auxiliary brush, as shown in Fig. 3, to provide adequate overlap when the connecting plug is withdrawn or inserted. Some circuits are equipped with shorting bars (see Fig. 8 for SAM14B) and on these circuits it is especially important that the auxiliary brush make contact as indicated in Fig. 3 with adequate pressure to prevent the opening of important interlock circuits.

The cradle assembly includes the two printed circuit card assemblies for the zone-2 and zone-3 time measuring circuits, the rheostats used in setting the time, dropping resistors used in the DC voltage selection, three auxiliary telephone-type relays (TX, TU2 and TU3), and the target units (two in Type SAM14A, three in Type SAM14B). The location of these components is indicated in Fig. 1 and 2. Component designations in these figures agree with the designations on the internal connection diagrams in Figs. 7 and 8.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as a part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a claim at once with the transportation company and promptly notify the nearest General Electric Sales Office.

Reasonable care should be exercised in unpacking the relay. If the relays are not to be installed immediately, they should be stored in their original cartons in a

place that is free from moisture, dust and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed and cause trouble in the operation of the relay.

ACCEPTANCE TESTS

Immediately upon receipt of the relay an INSPECTION AND ACCEPTANCE TEST should be made to make sure that no damage has been sustained in shipment and that the relay calibrations have not been disturbed. If the examination or test indicates that readjustment is necessary, refer to the section on SERVICING.

Visual Inspection

Cheek the nameplate stamping to make sure that the model number and rating of the relay agree with the requisition.

Remove the relay from its case and check that there are no broken or cracked molded parts or other signs of physical damage. The printed circuit cards should be held securely in their receptacles by the grooved clamping plate on the left side of the relay.

Mechanical Inspection

It is recommended that the following mechanical adjustments be checked:

1. Operate each auxiliary telephone-type unit (TX, TU2 and TU3) manually to be sure the armatures are moving freely. With the armature closed the normally closed contacts should make with approximately .005" wiper. This can be checked by inserting a .005" shim between the residual screw and the pole piece and operating the armature by hand. The N.O. contacts should make before the residual screw strikes the shim.

With the armature open, each normally open contact should have a gap of 0.010" to 0.015".

2. The armature of each target unit should move freely when operated by hand, and the target should latch in the exposed position before the armature strikes the pole piece.

With all targets latched in the exposed position and the cradle assembly in the case, replace the cover and make sure that the targets can be reset by means of the button at the lower left corner of the cover.

3. Check the location of the contact brushes on the cradle and case blocks against the internal connection diagram (Fig. 7 or 8). Where a shorting bar is shown on the internal connections (Fig. 8), be sure it is present in the proper position on the case block.

Electrical Tests

It is recommended that the following electrical tests be made immediately upon receipt of the relay. All tests should be made with the relay in its case and in a reasonably level position.

1. TX Unit Pickup - Connect the relay to a source of adjustable DC voltage as shown in Fig.10, being sure to observe polarity since this is important in subsequent tests. As shipped from the factory, the DC voltage selection link should be in the

125 VDC position. Check that it is in this position. Then close switch S1 and slowly increase the voltage until the TX unit operates. It should operate at less than 50% of rated DC voltage, that is less than 62 volts for the 125 volt link setting.

Now shift the link to the 48 volt position, and then to the 250 volt position, and check that TX picks up at less than 50% of link setting in each case. Return the link to the 125 volt position before proceeding with the time checks.

It will be noted on the internal connections (Fig. 7 or 8) that the TX unit may be energized from either stud 7 or 8. In the test connections of Fig. 10, shift the lead from stud 7 to stud 8 of the test plug and check that TX picks up at the same value for this input connection.

2. Time Checks - As shipped from the factory the adjusting knobs for the zone-2 and zone-3 timing circuits are both set at the maximum scale calibration position (3 seconds for the typical timing relay used on distance relay applications). Connect an electronic timer to be started by switch S1 and stopped by the zone-2 contact (TU2) as shown in Fig. 10. Check that TU2 is operating within $\pm 3\%$ of the dial marking (between 2.91 and 3.09 seconds for the 3 sec. timer). Now shift the timer-stop leads to studs 8-9 for the SAM14B relay only, as shown by the dotted connections in Fig. 10, and check that the zone-3 timing circuit is operating within $\pm 3\%$ of the maximum scale marking.

Note that the diagram in Fig. 10 applies specifically to the Type SAM14B timing relay. The test connections for the Type SAM14A are similar, except that to check the zone-3 timing circuit the electronic timer stop leads should be connected to studs 9-10 instead of 8-9 (see Fig. 7).

3. Target Operation - The zone targets in the SAM14 timers have operating coils tapped at 1.0 or 4.0 amperes. The relay is shipped from the factory with the tap screws in the 1.0 ampere position.

The operating point of the zone targets can be checked by connecting the target coil in series with an adjustable DC current source. Refer to the internal connections in Fig. 7 or 8 for the studs to use for each target. Note that when the zone-3 target is checked, the TU3 contact must be closed. The targets should operate at tap value or slightly lower.

INSTALLATION PROCEDURE

Location

The location of the relay should be clean and dry, free from dust, excessive heat and vibration, and should be well lighted to facilitate inspection and testing.

Mounting

The relay should be mounted on a vertical surface. The outline and panel drilling dimensions are shown in Fig. 11.

Connections

Internal connections are shown in Fig. 7 for the SAM14A, and Fig. 8 for the SAM14B. The legend for these two figures is in Fig. 9. An elementary diagram showing typical external connections for the SAM14B is shown in Fig. 4.

Inspection

If the relay has been stored for any length of time prior to installation, it is recommended that the visual and mechanical inspection points and the electrical tests listed under ACCEPTANCE TESTS be repeated.

Voltage Selection Link

Before proceeding with the installation checks, be sure that the DC voltage selection link is in the correct position for the application.

Time Setting

At the time of installation the zone-2 and zone-3 timing circuits should be set for the operating time required for the particular application. This is accomplished by means of the calibration knobs accessible from the front of the relay (see Fig. 1). These knobs control adjustment rheostats R_1 and R_2 shown in Figs. 7 and 8. Fairly accurate settings, within $\pm 3\%$ of the dial marking, can be obtained by setting the knob at one of the seven etched calibration points, or approximate settings can be obtained by interpolating between two of the set points. The expanded scale will facilitate approximate time settings at the low end of the range.

If more accurate time settings are desired, the test circuit shown in Fig. 10, and described under ACCEPTANCE TESTS, should be used. As shipped from the factory the shafts of calibration rheostats R_1 and R_2 are clamped in the set position by means of the round locking nuts located behind the calibration knobs. Before attempting a change in the setting of the calibration rheostats, their shafts should be released by loosening the locking nut. The calibration knobs should then be set at the required position, as determined by the timing scheme shown in Fig. 10. An electronic timer should be used in making these settings. After the calibration knobs have been set, clamp the rheostat shafts by turning the locking nuts in a clockwise direction. Then recheck the time again, since it is possible that the rheostat settings may be slightly disturbed when the locking knobs are tightened. If a slight refinement in the time setting is necessary, make this adjustment without releasing the locking knob.

Target Tap Setting

Be sure that the tap screw on the right side of each target is in the correct position for the application. Normally the 1-ampere tap is used for 125 or 250 volt DC installations and the 4-ampere tap for 48 volts.

If it is necessary to change the tap setting, say from the 1-ampere to the 4-ampere tap, proceed as follows: Remove the spare screw from the left side of the target unit and insert it in the 4-ampere position of the right-hand tap plate. Then remove the screw from the 1-ampere tap and store it in the vacant position on the left side of the unit.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

In view of the vital role of protective relays in the operation of a power system, it is important that a periodic test program be followed. It is recognized that the interval between periodic checks will vary depending upon environment, type of relay, and the user's experience with periodic testing. Until the user has accumulated enough experience to select the test interval best suited to his individual requirements, it is suggested that the following points be checked at an interval of from one to two years.

1. Time Settings
2. Operation of TX Unit
3. Operation of Targets

The procedure outline under ACCEPTANCE TESTS and the connections of Fig. 10 can be followed.

Contact Cleaning

For cleaning relay contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etch-roughened surface resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet it will clean off any corrosion thoroughly and rapidly. Its flexibility ensures the cleaning of the actual points of contact. Do not use knives, files abrasive paper or cloth of any kind to clean relay contacts.

SERVICING

If it is found during the acceptance, installation or periodic test routines that any of the factory or field adjustments have been disturbed, the settings can be restored as outlined in the following paragraphs.

Auxiliary Units

Contact gaps of the telephone-type auxiliary units (TX, TU2 and TU3) can be adjusted by bending the stationary contact brush to obtain the specified 0.015" gap. After this adjustment is made, the wipe of the circuit-closing contacts should be checked to be sure it is still 0.005". Wipe can be restored by bending the moving contact brush as required.

If it is found that the voltage pickup of the TX unit is too high, it can be reduced by decreasing the gap between armature and pole face by bending the stop below the contact operating arm. To raise the pickup voltage, the armature gap should be increased. After this adjustment, it will be necessary to readjust the contacts to restore the 0.015" gap and the 0.005" wipe.

Timing Circuits

The factory calibration points scribed on the time dial for the zone-2 and zone-3 timing circuits are based on the time setting made by the R_1 and R_2 rheostats (see Fig. 1).

If it is found during periodic tests that the specific time settings for the installation are out of limits, restore the setting by means of the calibrating knobs on the front of the relay, using the connections of Fig. 10 and the description in the INSTALLATION PROCEDURE section (time settings).

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specify quantity required, name of the part wanted, and give complete nameplate data. If possible, give the General Electric requisition number on which the relay was furnished.

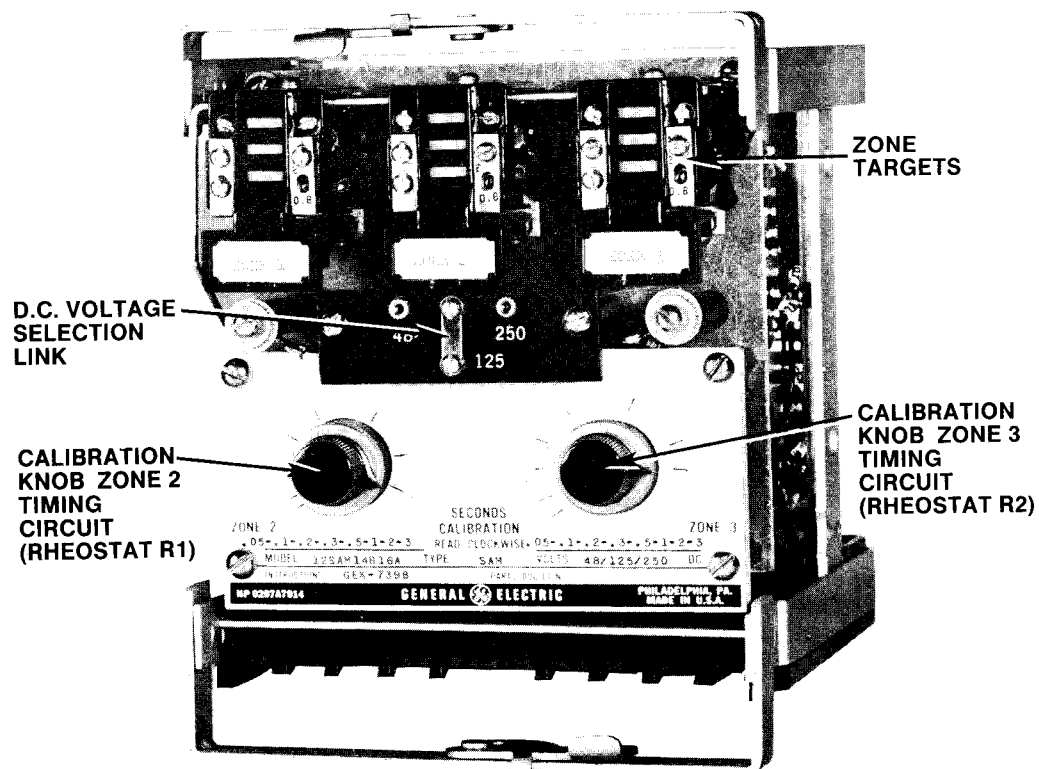


Fig. 1A (8039982) Relay Type SAM14BI6A Removed from Case (FRONT VIEW)

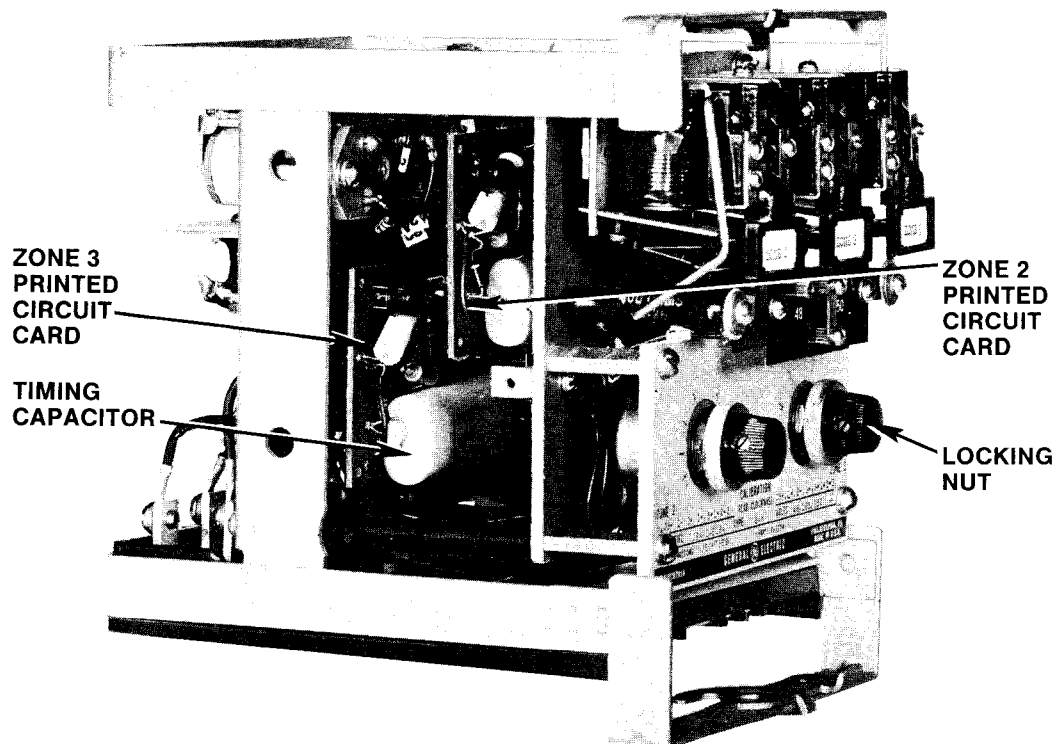


Fig. 1B (8039983) Relay Type SAM14BI6A Removed from Case (RIGHT SIDE VIEW)

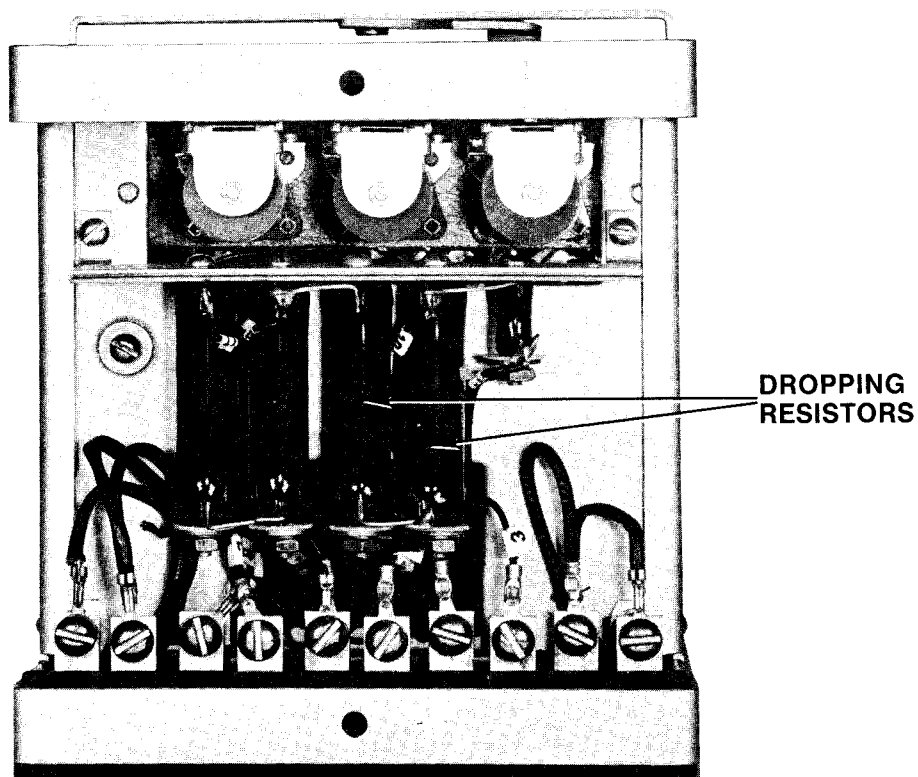
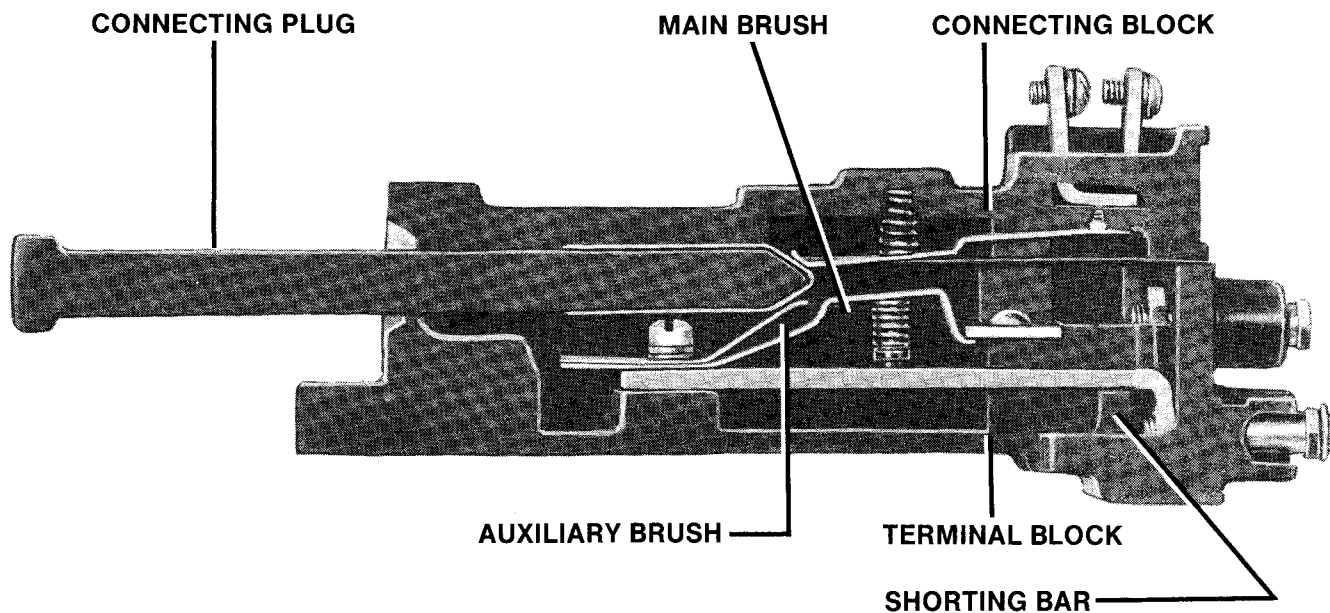


Fig. 2 (8039980) Relay Type SAM14B16A Removed from Case (REAR VIEW)



NOTE: AFTER ENGAGING AUXILIARY BRUSH CONNECTING PLUG TRAVELS $\frac{1}{4}$ INCH BEFORE ENGAGING THE MAIN BRUSH ON THE TERMINAL BLOCK.

Figure 3 (8025039) Cross Section of Drawout Case Showing Position of Auxiliary Brush

LEGEND			
DEVICE NO.	DEVICE TYPE	INC. ELEM.	DESCRIPTION
21	GCY		MHO TYPE STEP DISTANCE RELAY
		M1	1ST ZONE MHO UNIT
		M2	2ND ZONE MHO UNIT
		OM3	3RD ZONE MHO UNIT
		TR-1	TRANSACTOR INPUT TO M1
		TR-3	TRANSACTOR INPUT TO OM3
		T&SI	TARGET & SEAL-IN
21X	SAM	TA1	ZONE 1 TARGET
		TA2	ZONE 2 TARGET
		TA3	ZONE 3 TARGET
		TU2	FIRST TIMING CONTACT TO CLOSE
		TU3	SECOND TIMING CONTACT TO CLOSE
		TX	AUXILIARY FOR TIMING UNIT
50	PJC		CURRENT FAULT DETECTOR
		T&SI	TARGET AND SEAL-IN
52			CIRCUIT BREAKER
		a	AUXILIARY SWITCH
		TC	TRIP COIL
50			CURRENT FAULT DETECTOR
94	HGA14AM OR AL		AUXILIARY TRIPPING RELAY

TABULATION OF DEVICES			
TYPE OR DESCRIPTION		INT. CONN.	OUTLINE
GCY51A		0178A7049	K-6209276
SAM14B		208A2427	K-6209271
PJC31C		K-6375726	K-6209272
CHC12A		0148A3956	K-6209272
TRIP RECTIFIER(1021218G-2)	125V.		104A8584
TRIP RECTIFIER(1021218G-4)	250V.		104A8584

Figure 4 (116B9304 [5]) Three-Step Distance Protection for a Transmission Line Using Three Type GCY51A and One Type SAM14B Timing Relay (continued next page)

PHASE SEQUENCE
1-2-3
OR
3-2-1

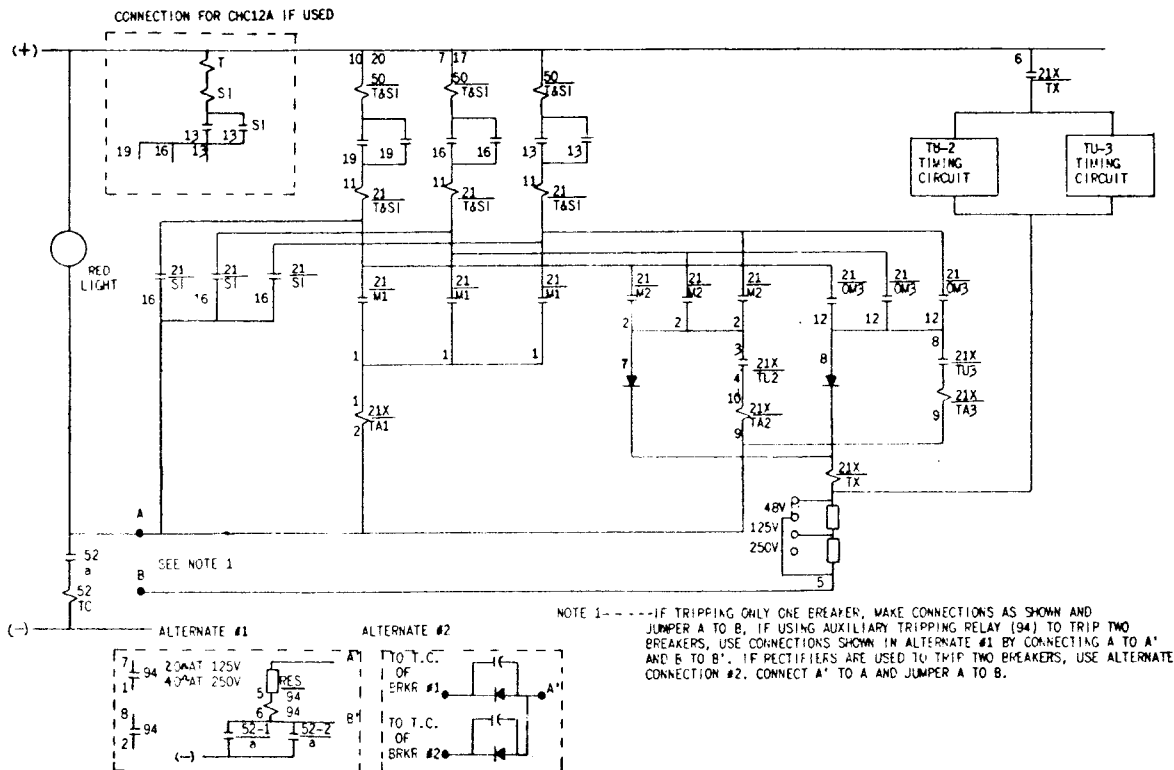
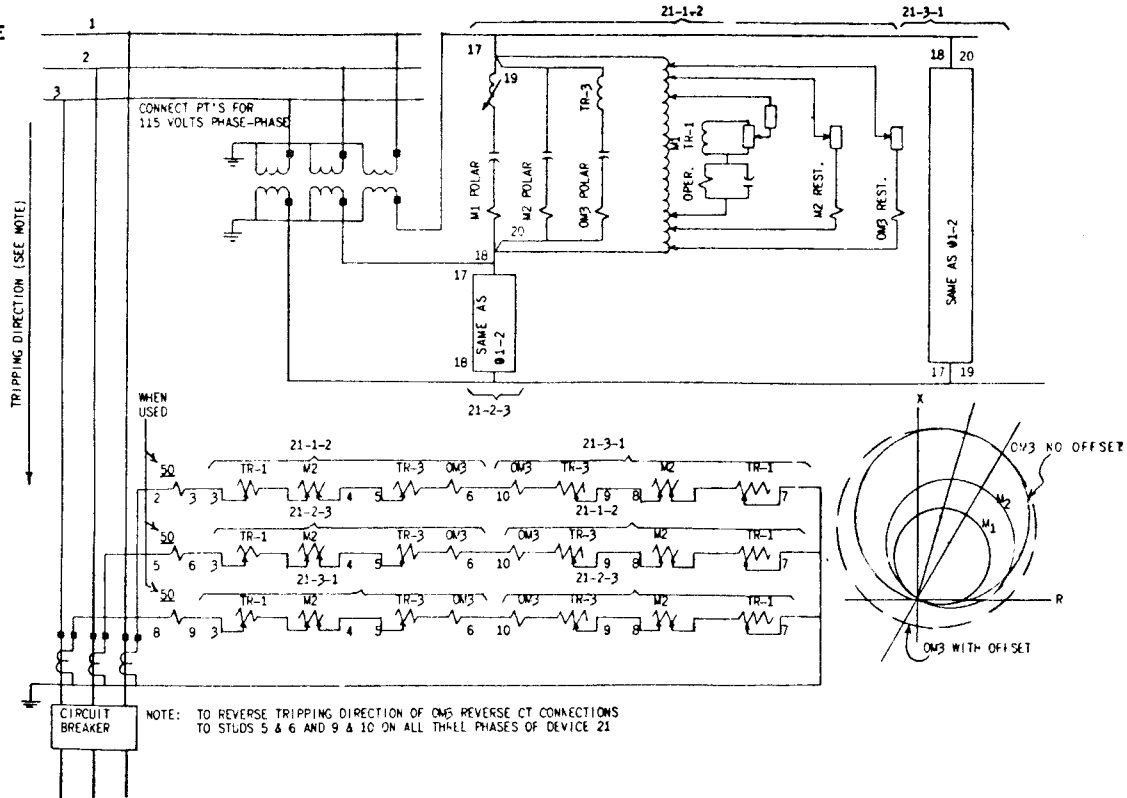


Figure 4 (continued) (116B9304 [5]) Three-Step Distance Protection for a Transmission Line Using Three Type GCY51A and One Type SAM14B Timing Relay

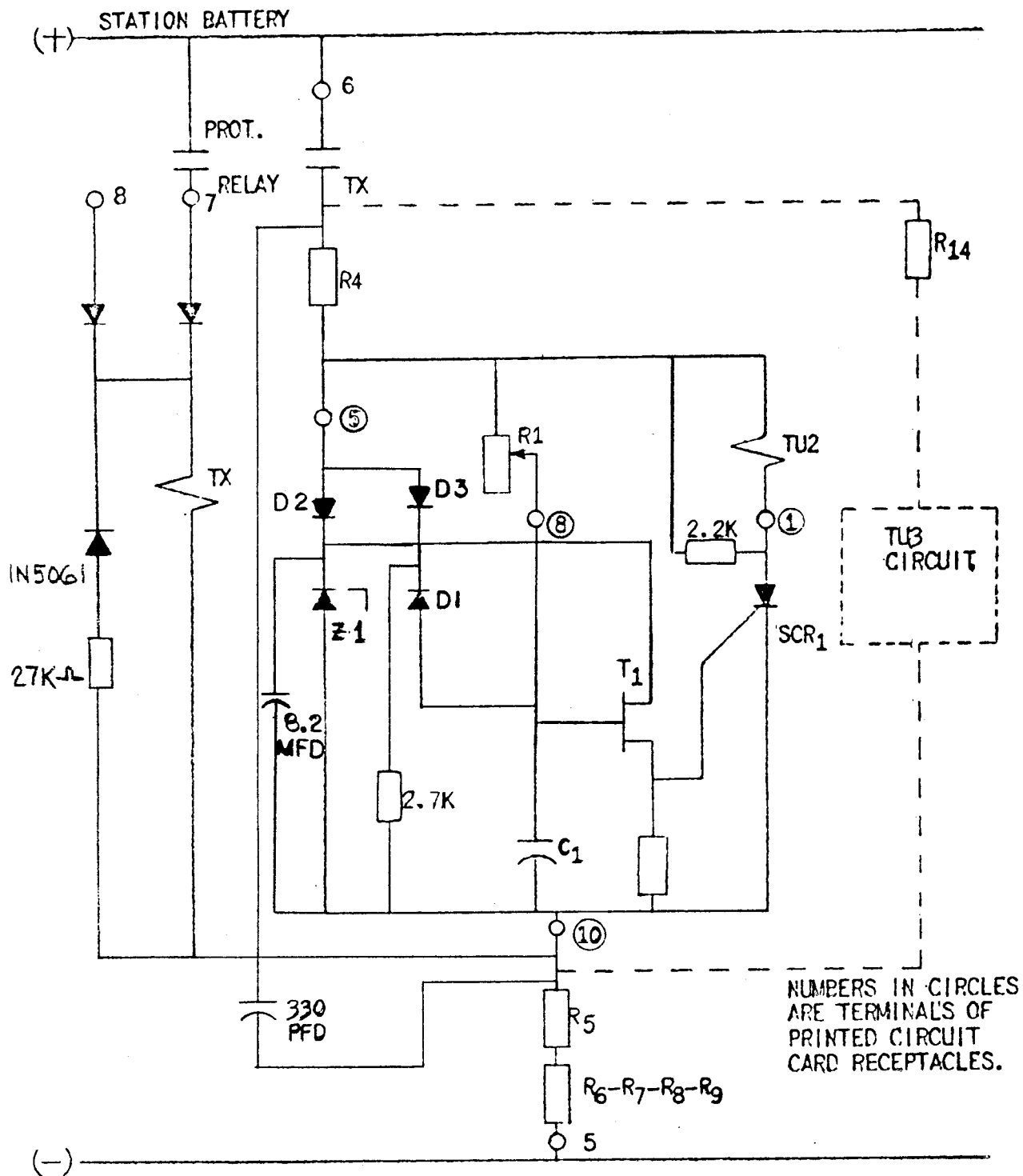


Figure 5 (2082485 [3]) Simplified Schematic Diagram of Timing Circuit used in SAM14A and SAM14B Relays

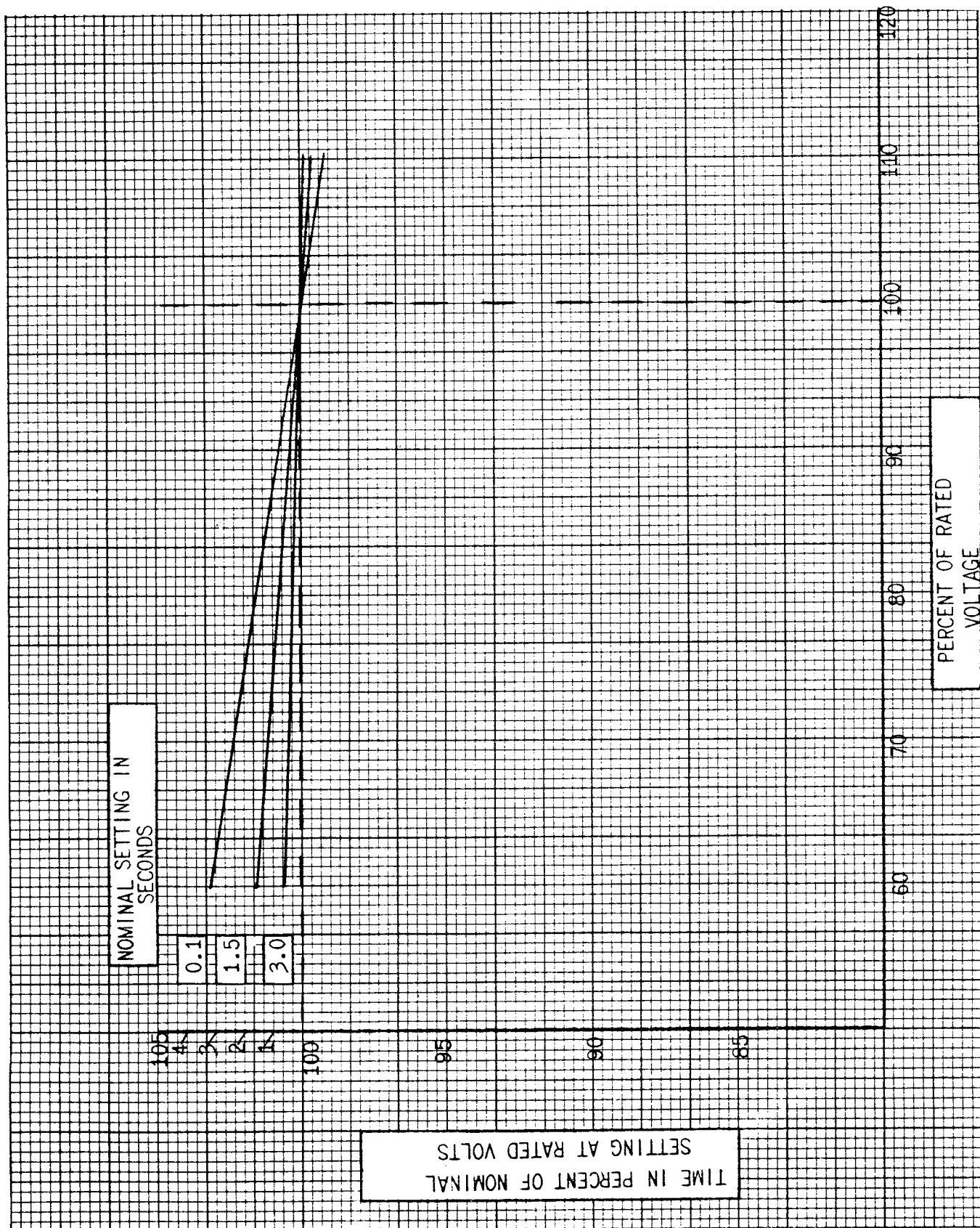


Figure 6 (178A8162) Variation in Operating Time With Change in DC Control Voltage for SAM14 Relays

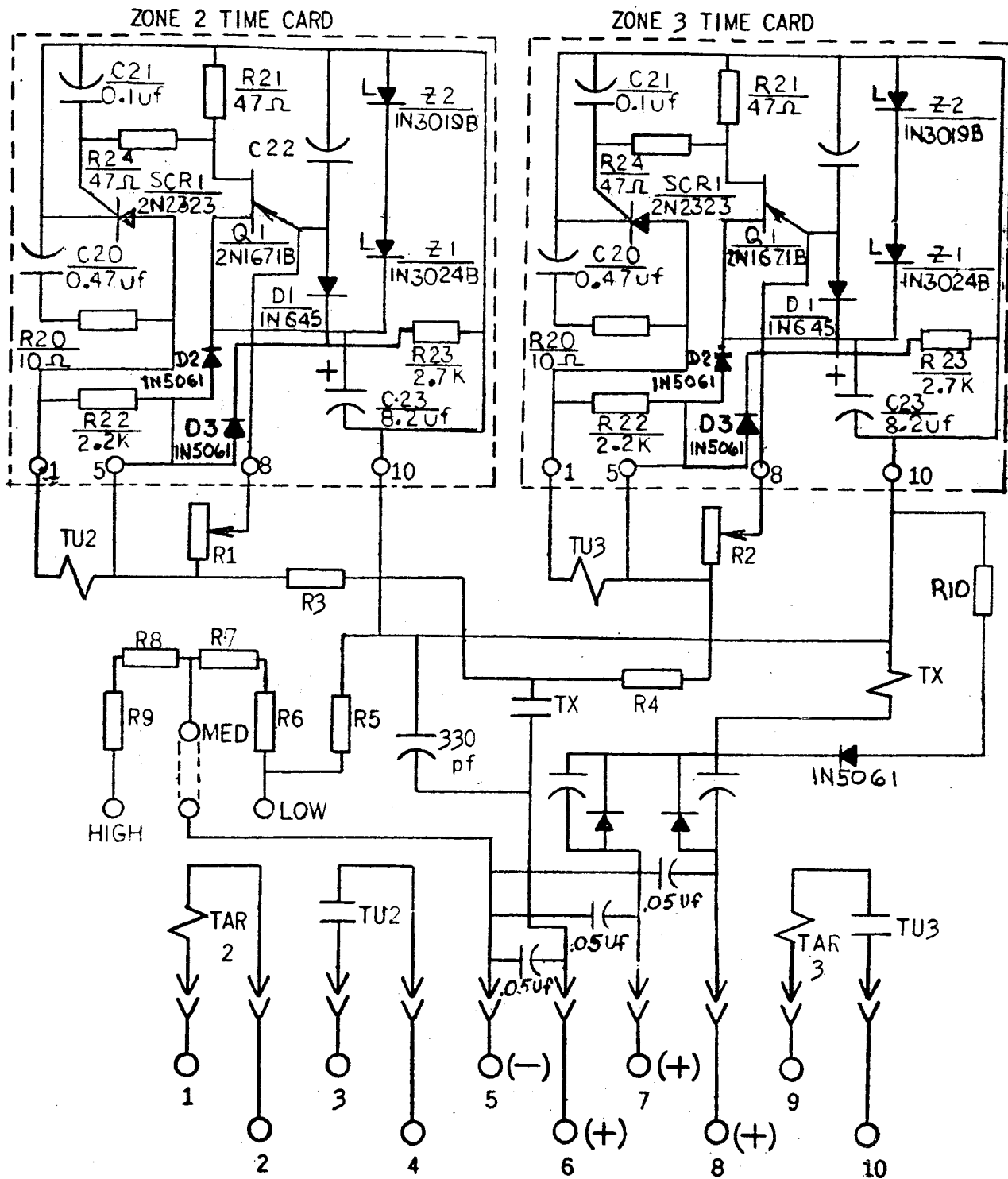
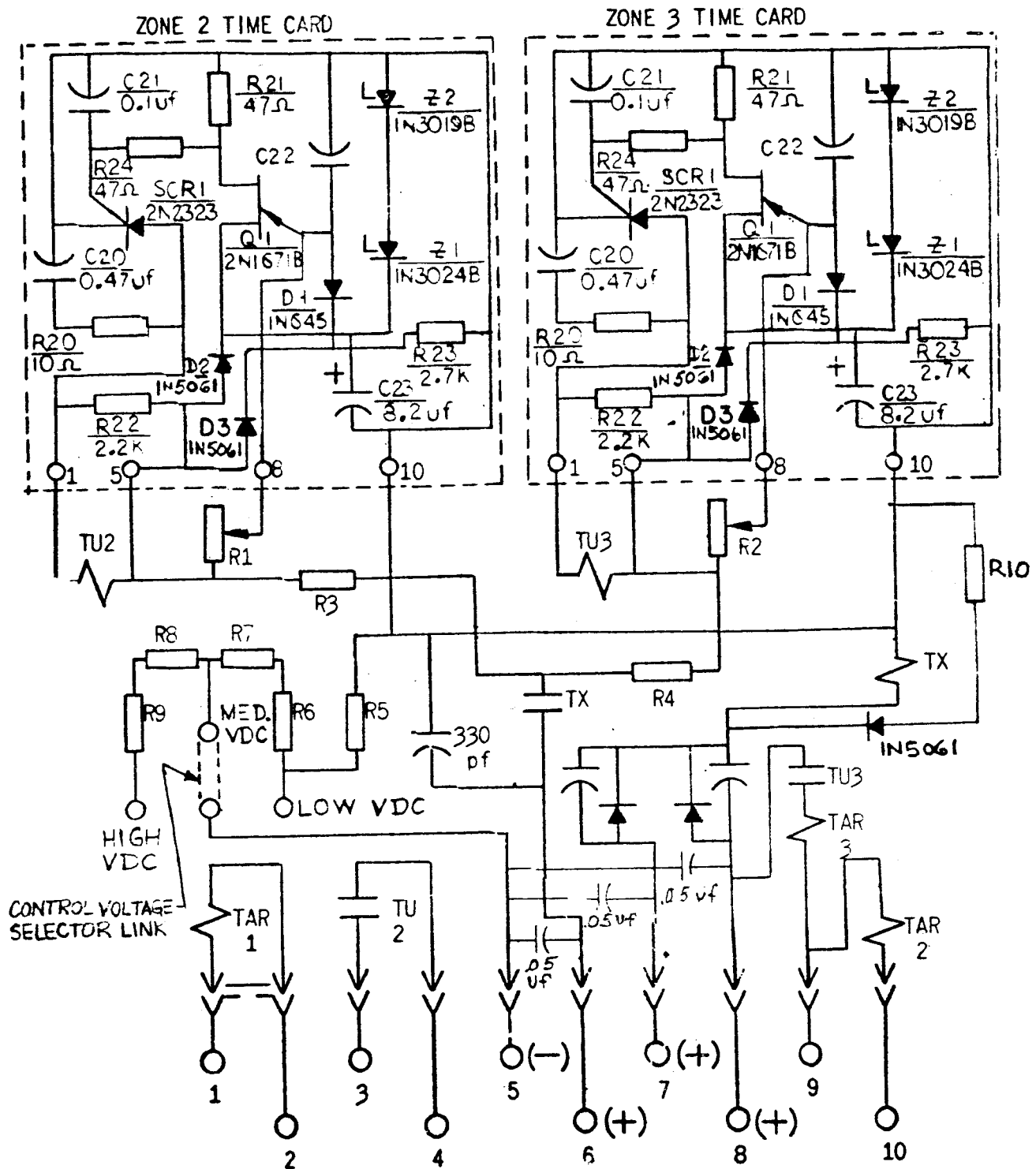


Fig. 7 (0208A2426 Sh.1 [7]) Internal Connection for Relay SAM14A12 and Up (Front View)



5○=TIP NO. ON PRINTED CIRCUIT CARD

Fig. 8 (0208A2427 Sh.1 [8]) Internal Connection for Relay SAM14B15 and Up (Front View)

MODEL	FORM		
12SAM14A(-)A	12	13	14
VOLTS D.C.	48/125/ 250	48/125/ 250	48/110/ 220
RESISTANCE IN OHMS			
TX COIL	1300	1300	1300
TU2 COIL	650	650	650
TU3 COIL	650	650	650
R1	1.5 MEG.	1.5 MEG.	1.5 MEG.
R2	1.5 MEG.	1.5 MEG.	1.5 MEG.
R3	400	400	400
R4	400	400	400
R5	30	30	30
R6	250	250	200
R7	250	250	200
R8	375	375	350
R9	375	375	350
R10	27,000	27,000	27,000

Fig. 9 (0208A2426 Sh.2 [2]) Internal Connections for Type SAM Relays

MODEL	FORM		
12SAM14B(-)A	15, 16, 17	18, 19	
VOLTS D.C.	48/125/ 250	48/110/ 220	
RESISTANCE IN OHMS			
TX COIL	1300	1300	
TU2 COIL	650	650	
TU3 COIL	650	650	
* R1	1.5 MEG.	1.5 MEG.	
R2	1.5 MEG.	1.5 MEG.	
R3	400	400	
R4	400	400	
R5	30	30	
R6	250	100	
R7	250	250	
R8	375	300	
R9	375	375	
R10	27,000	27,000	

Fig. 9A (0208A2427 Sh.2 [3]) Internal Connections for Type SAM Relays

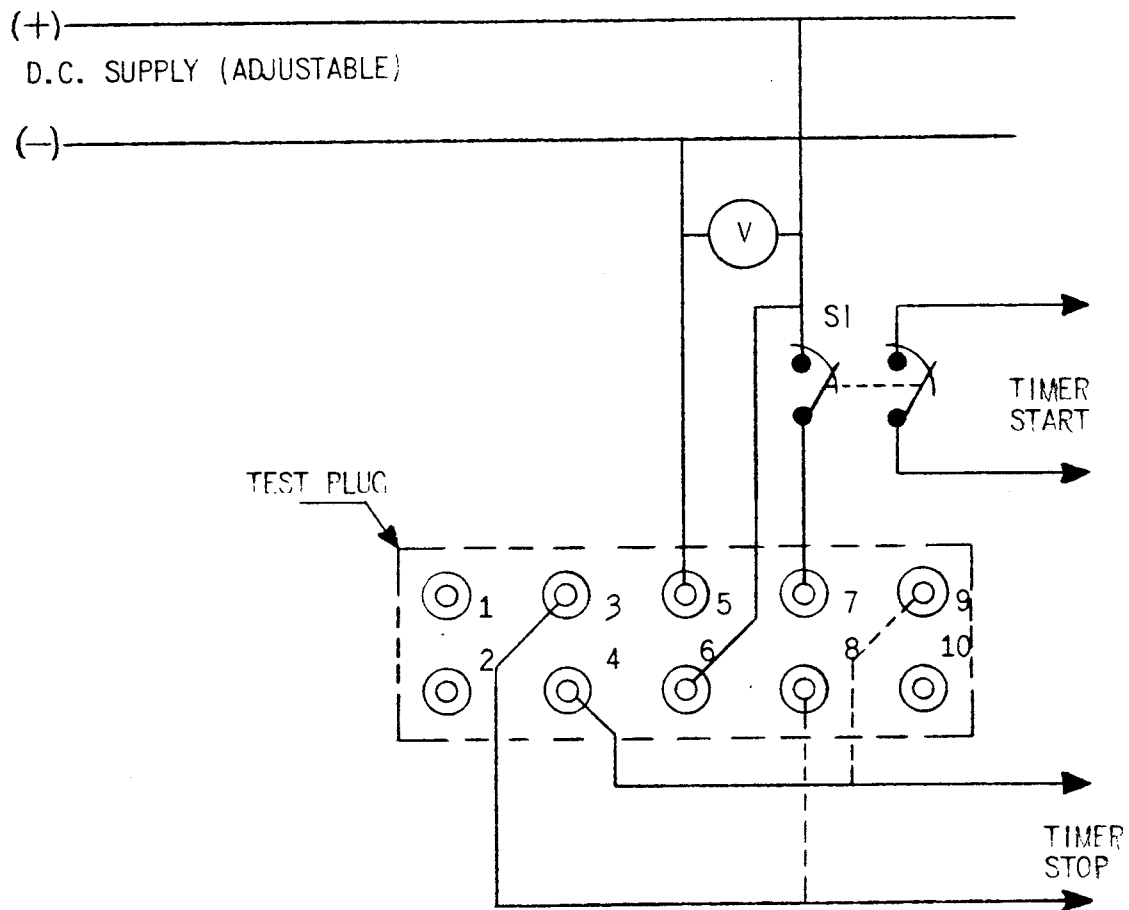


Figure 10 (0178A8161) Test Connections for SAM14B Relays in using XLA Test Plug

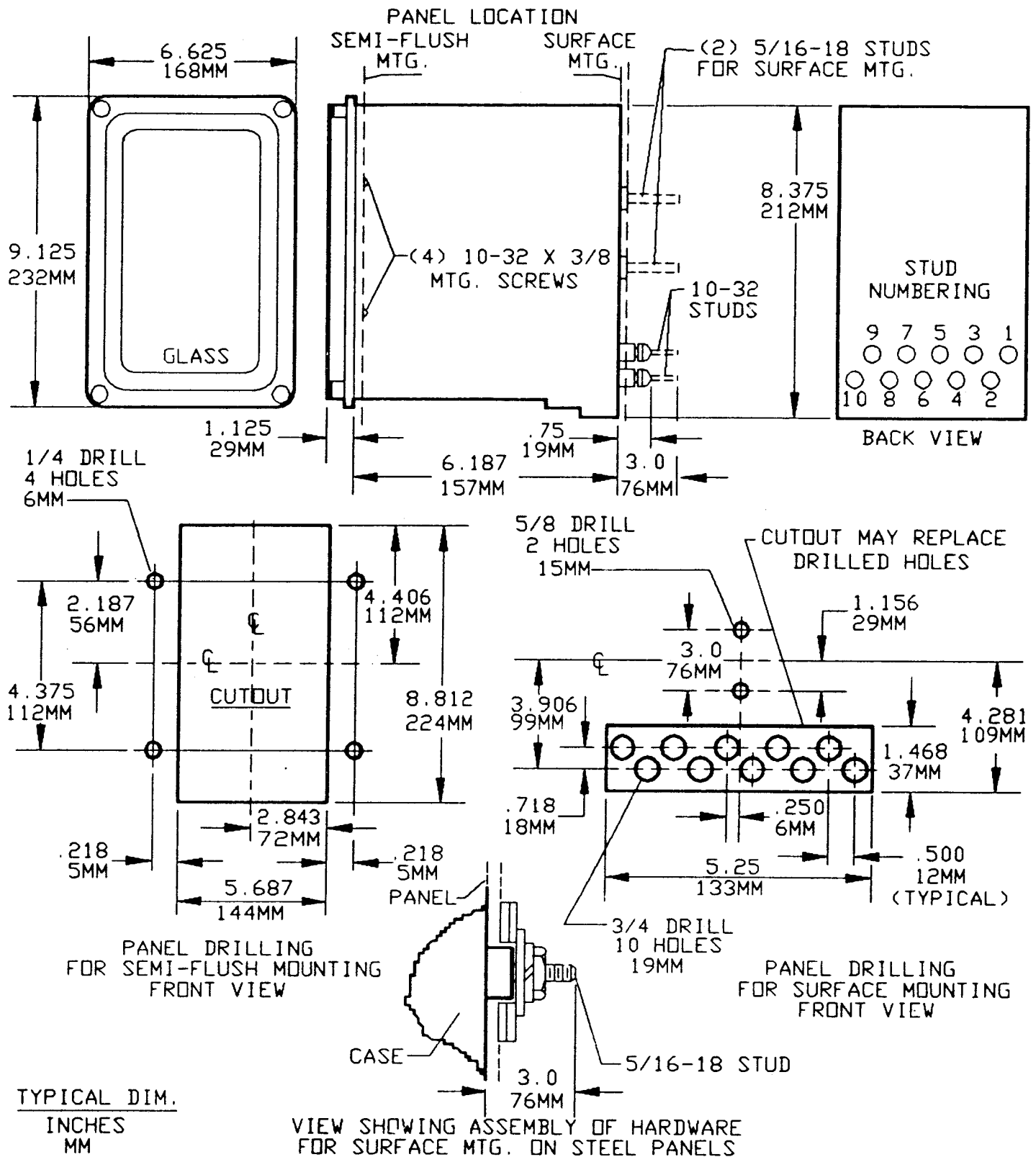


Fig. 11 (K-6209271 [8]) Outline and Panel Drilling Dimensions for Drawout Relays

Since the last edition, the text has been newly set and changes have been made in Figures 5, 7, 8, 9, and 9A.

**Protection and Control
Business Department**

(4/93) (500)

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